

**IN THE SPECIFICATION:**

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**METHOD AND DEVICE FOR REGULATING A VOLTAGE SUPPLY TO A  
SEMICONDUCTOR DEVICE**

**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of United Kingdom patent application nos. 0326862.0 and 0326864.6.

**FIELD OF THE INVENTION**

The present invention relates to a method and device for regulating a voltage supply to a semiconductor device.

**BACKGROUND OF THE INVENTION**

As the demand for portable electronic devices has increased so correspondingly has the requirement for increased battery life and processor performance.

While processor performance has continued to increase at a rapid rate, improvements in battery performance have not.

Additionally, in many cases the increase in processor performance has resulted in an increased power usage, which could result in many cases in a reduced battery life.

Consequently, there is a continuing drive to reduce power usage.

One solution that manufactures have used to reduce power usage within portable electronic devices has included temporarily turning off unneeded peripherals; blocks of on-chip memory and, during idle periods, the processor itself.

A second solution involves lowering the supply voltage to an integrated circuit to the lowest voltage that is necessary to maintain the performance of the integrated circuit. This solution is based on the principle that the specified voltage supply requirements for an integrated circuit are based upon worst case conditions, for example worst case operational temperature and the quality of the

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#### **BRIEF SUMMARY OF THE INVENTION**

In accordance with a first aspect of the present invention there is provided a device for regulating a voltage supply to a semiconductor device according to claim 1.

This provides the advantage of allowing a minimum voltage supply to be determined quickly and without having to perform performance limit calculations.

In accordance with a second aspect of the present invention there is provided a method for regulating a voltage supply to a semiconductor device according to claim 8.

In accordance with a third aspect of the present invention there is provided a device for regulating a voltage supply to a semiconductor device according to claim 19.

This provides the advantage of allowing the voltage supply to an integrated circuit to be set based upon both the processing load on the integrated circuit and the operating conditions and manufacturing process of the integrated circuit. Additionally, short voltage switching times are achievable allowing power saving and optimal voltage levels are set during frequency scaling.

In accordance with a fourth aspect of the present invention there is provided a method for regulating a voltage supply to a semiconductor device according to claim 28.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

An embodiment of the invention will now be described, by way of example, with reference to the drawings, of which:

Figure 1 illustrates an arrangement for regulating a voltage supply to a semiconductor device according to an embodiment of the present invention;

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Figure 2 illustrates a look-up table according to an embodiment of the present invention;

Figure 3 illustrates a graphical representation of a look-up table according to an embodiment of the present invention and;

Figure 4 illustrates a set of look-up tables for a set of respective operating frequencies of an integrated circuit according to an embodiment of the present invention.

**DESCRIPTION OF PREFERRED EMBODIMENT(S)**

Figure 1 shows an integrated circuit 100, a power management module 101 having a voltage supply regulator 112 for providing a supply voltage to the integrated circuit 100, a software module 102 for controlling the regulation of the supply voltage to the integrated circuit 100 and a memory module 103 having a look-up table 104 for storing performance data associated the integrated circuit 100. It is envisaged that the look-up table 104 may comprise a set of look-up tables.

The integrated circuit includes a reference counting circuit 106, a ring oscillator 107 that acts as a reference circuit, three comparators 108, 109, 110 and a look-up table register 111. It should be noted, however, that the comparators 108, 109, 110 and the look-up table register 111 could be located off chip from the integrated circuit 100.

The ring oscillator 107 (i.e. reference circuit) is arranged to generate a free running reference clock signal that is provided to the reference counting circuit 106. The reference circuit 107 is a subset of the circuits formed on the integrated circuit 100 and is used as a measure of the performance of the integrated circuit 100. The purpose of using the reference circuit 107 is to determine the